Neighbourhood environment and positive mental health in older people

Neighbourhood environment and positive mental health in older people: the Hertfordshire Cohort Study

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Abstract

Little is known about the potential effects of neighbourhood environment on positive mental health in older people. We examined cross-sectional associations between the Index of Multiple Deprivation Score of the census area of residence, perceptions of neighbourhood cohesion and neighbourhood problems and mental wellbeing, as measured by the Warwick-Edinburgh Mental wellbeing Scale, in 1157 men and women aged 69-78 years from Hertfordshire, UK. We found no association between area-level deprivation and mental wellbeing. People who felt a stronger sense of cohesion within their neighbourhood and reported fewer neighbourhood problems had higher levels of mental wellbeing, independently of social class, income, presence of limiting illness or disability, mobility problems, and perceived social support. Adjustment for emotional stability attenuated the associations between mental wellbeing and both these measures of perceived neighbourhood environment, particularly in the case of neighbourhood problems. How older people feel about their neighbourhood may be important for positive mental health in later life.

Key words: mental wellbeing, neighbourhood cohesion, neighbourhood problems, area deprivation, emotional stability

Introduction

There is some evidence that neighbourhood environment may be important for mental health. Living in an area that has more socioeconomic deprivation has been linked with a higher prevalence of anxiety and depression (Fone et al. 2007), an increased risk of incident depression (Galea et al. 2007), and a greater likelihood of admission to psychiatric hospital, independently of individual-level socioeconomic factors (Sundquist & Ahlen 2006). But this is not a consistent finding: studies from Sweden (Lofors, Ramirez-Leon, & Sundquist 2006), the UK (Propper et al. 2005), and the Netherlands (Reijneveld & Schene 1998) found that neighbourhood deprivation appeared to have little or no influence on the prevalence of anxiety or depression once individual socioeconomic status had been accounted for.

Fewer studies have examined the potential effect of neighbourhood environment on mental health in older people (Yen, Michael, & Perdue 2009). It seems plausible that characteristics of the immediate residential neighbourhood may be more important for mental wellbeing at older ages because such individuals are less likely to go out to work and have an increased risk of mobility limitations. Yet findings on the relation between neighbourhood socioeconomic deprivation and depressive symptoms in older people have been as inconsistent as those in the general population, with two studies finding a significant association between neighbourhood poverty and increased depression after adjustment for individual characteristics (Kubzansky et al. 2005;Ostir et al. 2003), but others showing no effect (Aneshensel et al. 2007;Walters et al. 2004). There is only limited evidence on the relationship between perceived aspects of neighbourhood and mental health in older people, but findings linking self-reports of problems with the neighbourhood (Schieman & Meersman 2004), neighbourhood social environment (Brown et al.

2009) and sense of belonging to a neighbourhood (Young, Russell, & Powers 2004) with psychological distress in older people suggest that how individuals feel about the physical and social environment where they live may be more strongly associated with their mental health than objective, area-level measures of neighbourhood deprivation.

Most studies into the relation between neighbourhood and mental health have assessed symptoms of depression or anxiety. Such measures have drawbacks as an indicator of the continuum of mental wellbeing in population samples because of their ceiling effects; in other words a large proportion of respondents will report no such symptoms. The Warwick-Edinburgh Mental wellbeing Scale was developed specifically to measure mental well being in population samples, focusing entirely on positive aspects of mental health (Tennant et al. 2007). We used this measure in a survey of men and women aged 69 to 78 years, and investigated the cross-sectional relations between neighbourhood area-level deprivation, perceptions of neighbourhood problems and neighbourhood cohesion, and positive mental health. We were able to examine the role of several other factors that could potentially confound or mediate any association between our measures of neighbourhood environment and positive mental health, including individual socioeconomic circumstances, presence of limiting long-term illness or disability, the personality trait emotional stability (or neuroticism), and perceived level of social support. Our hypothesis was that how older people felt about neighbourhood problems and how strongly they felt a sense of cohesion with their neighbourhood would be more strongly linked to their positive mental health than an objective measure of deprivation in their area.

Methods

Participants

In 1998-2004, men and women born in Hertfordshire between 1931 and 1939 and still living in the county were recruited to take part in a cohort study to evaluate interactions between the genome, the intrauterine and early postnatal environment, and adult lifestyle in the aetiology of chronic disorders of later life. A description of the setting up of the Hertfordshire Cohort Study has been published previously (Syddall et al. 2005). Of 6099 people invited to take part in the initial survey, 3225 (53%) agreed to be interviewed. In 2008, surviving participants were invited to take part in a postal survey. Of 2689 people approached, 1417 (53%) returned a completed questionnaire. The study was approved by the Hertfordshire Research Ethics Committee.

Measures

Positive mental health

Positive mental health or mental wellbeing was assessed using the Warwick-Edinburgh Mental Mental wellbeing Scale. This scale was developed recently to measure a wide conception of mental wellbeing - including positive affect, psychological functioning, and interpersonal relationships – and to be suitable for use in population surveys (Tennant et al. 2007). Confirmatory factor analysis suggests it measures a single underlying concept (Tennant et al. 2007). It has been validated on a representative general population sample of adults, but, to our knowledge, has not yet been validated specifically in older people. The scale consists of 14

positively-worded statements. Examples include 'I've been feeling optimistic about the future', 'I've been feeling interested in other people, 'I've been dealing with problems well', 'I've been feeling good about myself'. For each statement, respondents are asked to indicate which of five options, ranging from none of the time (score 1) to all of the time (score 5), best describes their experience over the last two weeks. The overall score is calculated by summing the scores for each item. A higher score indicates a higher level of mental mental wellbeing or positive mental health. The Cronbach alpha for the 14 items in these data was 0.91, suggesting good internal consistency.

Neighbourhood deprivation

We linked the postcodes of the participants' current address to the 2001 census lower super output areas (LSOAs) using the GeoConvert online geography matching tool freely available to UK academics, and thence to scores on the Index of Multiple Deprivation (IMD) 2007 (Noble et al. 2008). The IMD provides a measure of area-level multiple deprivation by combining information on seven domains of deprivation - income, employment, health and disability, education, skills and training, barriers to housing and services, crime, and living environment. The higher the IMD score, the more deprived the area of residence.

Neighbourhood cohesion

Sense of neighbourhood cohesion was assessed using eight items from the 18-item Neighbourhood Cohesion Scale that was developed to measure sense of community, attraction to neighbourhood and social interaction within it (Buckner 1988;Lochner, Kawachi, & Kennedy 1999). These eight items have previously been used in the British Household Panel Survey

(McCulloch 2003). Examples include 'I feel like I belong to this neighbourhood', 'The friendships and associations I have with other people in my neighbourhood mean a lot to me', and 'I would be willing to work together with others on something to improve my neighbourhood'. Respondents were asked to indicate how strongly they agreed or disagreed with each statement using five response options, ranging from strongly disagree (score 1) to strongly agree (score 5). Examination of the scree slope from a principal components analysis of these eight items suggested the presence of a single factor. We calculated an overall score by summing the scores for each item. Higher scores indicate a higher sense of neighbourhood cohesion. The Cronbach alpha of the eight items in these data was 0.86.

Neighbourhood problems

Perceptions of neighbourhood problems were assessed by asking respondents to consider a list of eight problems that people often have with the area where they live and indicate whether each one was a big problem (score 3), a small problem (score 2) or not a problem (score 1) for them. These and similar items have been widely used in UK government social surveys such as the General Household Survey. The eight problems were: vandalism, litter and rubbish, smells and fumes, assaults and muggings, burglaries, disturbance by children or youngsters, traffic, and noise. We calculated an overall score by summing the scores for each item. The Cronbach alpha of the eight items in these data was 0.82.

Covariates

Social class, income, presence of limiting long-term illness or disability, problems with mobility, the personality trait emotional stability and perceived social support were selected as potential confounding or mediating variables. Data on social class categorized in six groups according to the OPCS Occupational Classification scheme were derived from information on current or most recent job (in the case of married women, their husband's job) collected during the initial survey. In the follow-up questionnaire, participants were asked to indicate which out of eight income bands corresponded to their gross monthly income, and whether they had a long-term illness or disability that limited their activities. They were also asked how much difficulty they had, or would have, running for a bus or going up or down stairs: no difficulty (0), some difficulty (1), unable to do alone (2). We calculated a mobility problem score by summing scores on these two items. In addition, they completed the RAND Social Support Scale which assesses subjective impressions of how frequently different types of social support are available (Sherbourne & Hays 1990). The types of support assessed are emotional support, affectionate support, tangible support and positive interaction. Higher scores indicate greater levels of overall social support. Levels of the personality trait emotional stability (usually regarded as the opposite pole of neuroticism) were assessed using 10 items from the International Personality Item Pool (Goldberg 2001).

Statistical analysis

We used correlation coefficients to examine the relation between our three measures of neighbourhood environment (index of multiple deprivation score, neighbourhood problems and

neighbourhood cohesion) and other characteristics of the study participants. Spearman correlations were used instead of Pearson correlations for characteristics that were categorical or had a skewed distribution. Point bi-serial correlations were used for binary variables. *T*-tests were used to examine the relation between mental wellbeing scores and binary variables. Because the index of multiple deprivation (IMD) is an area-level measure and there were on average 23.3 study participants per census area, we initially used a two-level random-effects model to examine the relation between IMD score and mental wellbeing in order to account for the likelihood that there would be greater similarity of observations within the same area than between area. We found that the variance of mental wellbeing between areas was underdispersed: in other words, there was less between-area variability in mental wellbeing than would be predicted from the within-area variability. We were therefore able to ignore area membership in our analysis, and focus exclusively on inter-individual variation using linear regression. These are the results that are described below. Preliminary analyses showed that results from the linear regression models were very similar for men and women, so we analysed men and women together and adjusted for sex

The analyses that follow are based on 1157 men and women with complete data on mental wellbeing, measures of neighbourhood environment and the covariates. This represents 82% of those who returned their questionnaire and 43% of the 2689 people who were invited to take part in the postal survey. Compared to the people in our analytical sample, those who were excluded from our analyses due to non-response (or missing data on some variables) were more likely at the time of the initial survey to have been depressed, as defined by a score of ≥8 on the Hospital Anxiety and Depression Scale (Zigmond & Snaith 1983), 6.5% *vs* 2.3%, $p<0.001$; to have reported their health as fair or poor, 15% *vs* 9% , $p<0.001$; and to belong to a manual

occupational social class, 64.5% *vs* 50.9%, p<0.001. People who were excluded from our analyses were also more likely than those in the analytical sample to be currently living in an area with greater deprivation, median IMD score 10.2 *vs* 8.48, p<0.001. There were no differences between the two groups in age or sex distribution.

Results

Table 1 describes the characteristics of the study participants and shows how those characteristics correlated with the three measures of neighbourhood environment. Although most of the correlations were statistically significant, they were all small in size. The index of multiple deprivation (IMD) score in the 64 census areas where the participants were living ranged from 1.03 to 42.4, with a median (interquartile range) score of 8.47 (5.01-14.5). People living in more deprived areas (as indicated by a higher IMD score) tended to report more problems with their neighbourhood and had a lower sense of neighbourhood cohesion. Individuals who were more disadvantaged in terms of their social class or their income, and those who had a limiting long-term illness or disability, were more likely to be living in an area with a higher level of multiple deprivation and to report more problems with their neighbourhood. Sense of neighbourhood cohesion, by contrast, was not associated with income or the presence of illness or disability, and tended to be slightly higher in people from more disadvantaged social classes. All three measures of neighbourhood environment were significantly associated with the personality trait emotional stability (scores for this trait ranged from 11 to 50): emotional stability tended to be greater in those living in less deprived areas, in those who reported fewer neighbourhood problems and in those with a greater sense of neighbourhood cohesion. All three measures of

neighbourhood environment were also associated with mobility problems, such that people who reported having greater problems with mobility tended to live in more deprived areas, reported more neighbourhood problems and had a lower sense of neighbourhood cohesion. There was no association between the level of deprivation in an area and the amount of social support people living there felt they received, but people who reported more problems in their neighbourhood or who had a lower sense of neighbourhood cohesion felt they had less social support. We found no association between the age of our participants and any of the measures of neighbourhood environment. Women were slightly more likely than men to be living in areas with a higher IMD score.

Scores on the Warwick Edinburgh Mental Wellbeing Scale spanned the whole potential range (14 to 70) and its distribution was near normal (see Figure 1). (The range of mental wellbeing scores was still wide (20 to 70) when we excluded the people (n=31) known to have a history of anxiety or depression as defined by a score of ≥8 on the Hospital Anxiety and Depression Scale at the initial survey.) Women had slightly lower mental wellbeing scores than men, though this difference was of borderline significance: mean (SD) 51.2 (7.94) *vs* 52.1 (8.07), p=0.07. Mental wellbeing scores differed very little by age (r=0.01, p=0.87) or social class (r_s=-0.01, p=0.84), but were slightly higher in people with a larger income (r_s=0.06, p=0.03) and rose with increasing levels of social support (r=0.38, p<0.001) and emotional stability (r=0.56, p<0.001). Mental wellbeing scores were lower in those who reported having a limiting long-term illness or disability: mean (SD) 49.1 (8.12) vs 52.9 (7.66), p<0.001), and in those who reported more problems with mobility (r_s=-0.09, p=0.002) .

As Table 1 shows, the correlation between IMD scores in the area of residence and mental wellbeing was very small, but mental wellbeing tended to be lower in those who reported having

more problems with their neighbourhood and was markedly higher in those with higher neighbourhood cohesion scores. As an illustration of how mental wellbeing scores varied according to the perceived severity of neighbourhood problems, there was a 2.7 point difference in score (0.34 of a standard deviation) between those who reported that they had no problems with their neighbourhood and those who reported that they had four or five big problems.

In a linear regression model adjusting for sex there was no association between level of deprivation in the area of residence and mental wellbeing score: regression coefficient -0.041, 95% CI -0.11 to 0.02, p=0.216. We categorized IMD score into 6 groups in order to examine whether any difference in mental wellbeing according to level of area deprivation was restricted to those at the extremes of the distribution but there was no evidence of this.

Table 2 shows the results of simultaneous linear regression analyses into the relation between the two individual-level measures of neighbourhood environment – neighbourhood cohesion and neighbourhood problems – and mental wellbeing. Results for each measure of neighbourhood environment are expressed as standard deviation (SD) scores and shown adjusted first for sex (and for the other neighbourhood measure) and then separately for each potentially confounding or mediating factor so that the extent to which estimates are changed by the inclusion of each factor is clear.

In the initial model, there were significant independent associations between both measures of neighbourhood environment and mental wellbeing. People who had a greater sense of neighbourhood cohesion and who experienced fewer problems with their neighbourhood gained higher scores for mental wellbeing. Adjustment in model 2 for social class and income had no effect on the relation between neighbourhood cohesion and mental wellbeing and only slightly

attenuated the relation between neighbourhood problems and mental wellbeing. Adjustment in model 3 for presence of limiting long-term illness/disability or mobility problems attenuated the associations between both measures of neighbourhood environment and mental wellbeing, though they remained statistically significant. Adjustment for social support (model 4) or emotional stability (model 5) weakened the association between sense of neighbourhood cohesion and mental wellbeing, but in both cases it remained highly statistically significant. Adjustment for social support had only a small attenuating effect on the association between neighbourhood problems and mental wellbeing, but adjustment for emotional stability markedly weakened the association and it became of borderline statistical significance. When all the covariates were added simultaneously (model 6), a SD increase in neighbourhood cohesion score remained strongly associated with greater mental wellbeing (coefficient (95% CI) 1.99 (1.63, 2.34), $p<0.001$), while the relation between a SD increase in neighbourhood problem score and lower mental wellbeing was not statistically significant (coefficient (95% CI) -0.30 (-0.65, 0.05), $p=0.10$).

Discussion

In this cross-sectional study of 1157 men and women aged 69 to 78 years living in Hertfordshire, UK, we found that people who had a stronger sense of neighbourhood cohesion or who reported fewer problems with their neighbourhood had higher levels of mental wellbeing or positive mental health. These associations were independent of each other, and of social class, income, the presence of limiting long-term illness or disability, and degree of mobility problems. The relation between sense of neighbourhood cohesion and mental wellbeing was weakened slightly

by adjustment for the amount of social support people felt was available to them and for their degree of emotional stability, but it remained highly statistically significant. By contrast, the relation between reported neighbourhood problems and mental wellbeing was little changed when we adjusted for perceived social support, but was markedly attenuated by adjustment for emotional stability. We found no relation between level of deprivation in the area where the participants lived and mental wellbeing.

Mental wellbeing, or positive mental health, has been described as 'a condition in which individuals are fulfilling their potential and enjoying their life'(Huppert 2005). In other words, it is not just a matter of positive feelings, but also involves positive functioning (Keyes 2002). The concept of mental wellbeing and the dimensions it encompasses has been a matter of some debate. The hedonic perspective on wellbeing has focused on subjective feelings of happiness and satisfaction, while the eudaimonic perspective has focused on psychological functioning and fulfillment (Ryan & Deci 2001). The measure of mental wellbeing used in this study – the Warwick Edinburgh Mental Wellbeing Scale – was designed to capture a wide conception of wellbeing, incorporating both hedonic and eudaimonic aspects of positive mental health, including positive affect, satisfying interpersonal relationships and positive functioning (Tennant et al. 2007). The fact that scores on this scale were moderately correlated in our data with scores on a measure of neighbourhood cohesion (r=0.40) is perhaps unsurprising as both measures include some items that assess – using different wording – the social aspects of mental wellbeing, how individuals feels or function in relation to other people. As expected, scores on the Warwick Edinburgh Mental Wellbeing Scale tend to be lower in people with symptoms of anxiety and depression (Tennant et al. 2007), but the fact that in our data the range of mental wellbeing scores was still wide (20 to 70 compared to a potential range of 14 to 70) when we

excluded people with a history of anxiety or depression at the initial survey suggests that this measure is assessing a continuum of positive mental health.

The few previous investigations into the potential effect of neighbourhood environment on mental health in older people have tended to focus on negative mental health – symptoms of mental distress such as depression and anxiety. So far as we are aware, little is known about the relation between deprivation in the area of residence and positive mental health in older people. In a government health survey in Scotland, people aged 18 and over living in areas with more deprivation, as measured by the Scottish Index of Multiple Deprivation, had lower scores on the Warwick-Edinburgh Mental Mental wellbeing Scale (Corbett et al. 2010), but it is unclear whether the same relation was seen in older people or whether any such association was independent of individual-level socioeconomic circumstances. The fact that we found no association between Index of Multiple Deprivation score of the area of residence and scores on the Warwick-Edinburgh Mental Mental wellbeing Scale in older people may be a reflection of the relatively narrow range and low average level of area deprivation in our Hertfordshire sample compared to that found in other parts of the UK. However, it is also worth noting that in a systematic review of the potential impact of neighbourhood environment on health in older people, studies that used measures of neighbourhood environment that were based on individuals' perceptions tended to produce far stronger associations than those that used measures derived from objective data (Yen, Michael, & Perdue 2009). Our finding that perceptions of neighbourhood cohesion and neighbourhood problems were more strongly linked to our older participants' mental wellbeing than the level of deprivation in their neighbourhood is consistent with that.

There is evidence that how satisfied people are with the social support they receive is more strongly linked to their mental health than objective measures, such as frequency of contact with others (Jang et al. 2002). Older people who are less satisfied with the social support they perceive is available to them are more likely to develop symptoms of psychological distress. (Jang et al. 2002;Krause, Liang, & Yatomi 1989). In the present study, higher levels of perceived social support were associated with significantly greater mental wellbeing ($r=0.39$, $p<0.001$). Studies suggest that having more frequent positive contacts with neighbours results in an increase in perceived social support (Peirce et al. 2000). In a recent cross-sectional investigation of the relation between self-reported neighbourhood social environment and psychological distress in older people, the association between a more positive neighbourhood social environment and lower levels of psychological distress appeared to be entirely due to the fact that people who rated their neighbourhood as having a better social environment, in terms of involvement with neighbours and attachment to neighbourhood, felt they had more social support (Brown et al. 2009). In the present study, adjustment for perceived social support had the strongest attenuating effect on the relation between sense of neighbourhood cohesion and mental wellbeing of all our covariates, but the association remained strong. It may be that the link between a stronger sense of neighbourhood cohesion and greater mental wellbeing is due not just to the social support provided by neighbours but also to the feelings of purpose, satisfaction and happiness that can be produced by the provision of support and friendship to others and by level of connectedness to one's community (Unger & Wandersman 1985).

Emotional stability – or neuroticism – is a major determinant of subjective mental wellbeing and the propensity to become distressed (Lahey 2009). Yet although its influence has occasionally been considered in studies of area-based measures of neighbourhood environment and

depression (Beard et al. 2009), little is known about its effect on how individuals view their neighbourhood. Here, we found that older people who were less emotionally stable had a lower sense of neighbourhood cohesion and were more likely to have a higher score for perceptions of problems in their neighbourhood. Emotional stability appeared to account for at least some of the relation between sense of neighbourhood cohesion and mental wellbeing, and to explain to a large degree why people who felt there were more problems in their neighbourhood had lower levels of mental wellbeing. People who are low in emotional stability are more likely to respond to challenges with disproportionate feelings of anxiety, worry, sadness, irritability, and vulnerability (McCrae & Costa 2003). It has been suggested that interventions could help to increase levels of emotional stability in those with very low levels, though no such interventions have yet been identified (Lahey 2009). Our findings suggest that levels of this trait may be an important determinant of the extent to which perceptions of neighbourhood problems affect mental wellbeing in older people. There is evidence that people who are lower in emotional stability tend to appraise their environments in a more negative way (Gunthert, Cohen, & Armeli 1999;Tong et al. 2006). The link between how individuals appraise their environment and negative emotions appears to be much stronger in those who are low in emotional stability and this contributes to their susceptibility to distress (Tong 2010). It may be that in our participants, emotional stability affected both their perception of how they were affected by such potential neighbourhood problems as traffic, vandalism, burglaries, litter and noise, and their level of mental wellbeing.

Our study has some limitations. Firstly, although we had data on a range of potential confounding or mediating factors, including socioeconomic status, perceived social support, extent of mobility problems, presence of long-term illness or disability, and emotional stability,

we lacked more detailed information on current physical health, loneliness, marital status and recent bereavement, or cognitive function, all of which might have affected mental wellbeing and perceptions of neighbourhood.

Secondly, the cross-sectional design makes it impossible to be certain about the direction of effect between sense of neighbourhood cohesion, perceptions of neighbourhood problems and mental wellbeing. Although longitudinal studies have found evidence that neighbourhood environment has an influence on risk of later depression (Beard et al. 2009), it is also possible that current psychological state may affect people's sense of belonging to a neighbourhood and how they perceive their local environment (Lagory, Ward, & Sherman 1985). Perceptions of neighbourhood cohesion and neighbourhood environment may be more a reflection of respondents' mental wellbeing than an objective assessment of the place where they live.

Thirdly, our ability to detect the contextual effects of area deprivation may have been hampered. The geographical distribution of our sample was restricted to an average of 23 participants in 64 lower super output areas, so we may have lacked power to detect an effect in multi-level analyses. Furthermore, our sample is drawn from a single county which on average has low levels of deprivation compared to other parts of the UK (Noble et al. 2008). The geographical scale at which contextual factors might influence mental health is still uncertain (Macintyre, Ellaway, & Cummins 2002). Some US studies have found relationships between area deprivation and depression using data at the level of census tracts (Kubzansky et al. 2005;Ostir et al. 2003), but in the UK, two studies using a much smaller definition of area, the electoral ward, found no such link (McCulloch 2001;Weich et al. 2005), though there was some evidence that

local factors at the household level may influence the onset and maintenance of depression (Weich et al. 2005).

A fourth limitation of our study is that our analyses were based on 43% of the people who were invited to take part in our postal survey. Comparison of the analytical sample with those who were excluded because of non-response (or missing data on some variables) showed that people in the excluded group were more likely currently to be living in an area with greater deprivation, to belong to a manual social class, and to have a history of poorer physical or mental health at the time the cohort were first surveyed, though there was no difference in age or sex distribution. We have no information about differences in current mental health or perceptions of neighbourhood environment between our analytical sample and those in the excluded group. The range and average level of scores on the Warwick Edinburgh Mental wellbeing Scale in our sample were very similar to those observed in the 2008 Scottish Health Survey (Corbett et al. 2010;Tennant et al. 2007) which had a higher response rate (54%) than our study. However mean mental wellbeing scores in our sample were 2.4 points higher than those found in a survey of 50-year-olds where the response rate was 70% (Brown et al. 2010). If there is a bias towards greater mental wellbeing, better physical health and less deprivation among our respondents, it might perhaps have affected our ability to detect relationships between area deprivation, social class and mental wellbeing, but this bias would only be a matter of concern – and have implications for generalisability – if the relationships between the risk factors we examined and mental wellbeing differed systematically between those who took part and those who did not; this seems unlikely.

Our cohort members cannot be considered entirely typical of all men and women of this age in the UK because they have continued to live in the county of their birth. Cohort members have

been shown to be very similar to those in the nationally representative Health Survey for England on a range of characteristics (Syddall et al. 2005), but whether the relations between perceptions of neighbourhood environment and mental wellbeing would differ in populations with a higher proportion of migrants is unclear.

In this study, older people who felt a stronger sense of cohesion to their neighbourhood and who reported fewer problems with their neighbourhood had higher levels of positive mental health, independently of their socioeconomic status, income, state of health and perceived social support. By contrast, level of deprivation in their area of residence appeared to have no effect on their mental wellbeing. Our observation that emotional stability accounted for at least part of the link between perceptions of neighbourhood environment and mental wellbeing suggests that future research into the potential impact of neighbourhood characteristics on positive mental health in later life should consider the role of personality traits.

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Table 1: Characteristics of the study participants and correlations between those characteristics and measures of neighbourhood environment (n=1157)

Characteristics	Mean (SD) or No (%)	Correlation coefficient[1]		
		Index of multiple deprivation	Neighbourhood problems	Neighbourhood cohesion
Age, yrs	73.2 (2.47)	0.04	-0.01	-0.02
Female	558 (48.2)	0.07*	-0.06	-0.03
Social class		0.21***	0.07*	0.06*
I	92 (8.0)			
II	332 (28.7)			
III non manual	144 (12.5)			
III manual	403 (34.9)			
IV	158 (13.7)			
V	28 (2.4)			
Monthly gross income		-0.27***	-0.11**	0.04
<£400	86 (7.4)			
£401-£600	104 (9.0)			
£601-£800	151 (13.0)			
£801-£1200	300 (25.9)			
£1201-£1600	214 (18.5)			
£1601-£2000	119 (10.3)			
>£2000	183 (15.8)			
Has limiting long-term illness or disability	385 (33.3)	0.09**	0.09**	-0.05
Mobility problems	1 (0,2)[2]	0.10**	0.10**	-0.10**
Social support	19.56 (4.71)	-0.03	-0.09**	0.14***
Emotional stability	33.6 (7.72)	-0.09**	-0.15***	-0.14***
Index of multiple deprivation	8.47 (5.0-14.5)[2]	-	0.19***	-0.08**
Neighbourhood problems	11.0 (2.96)	0.19***	-	-0.12***
Neighbourhood cohesion	32.0 (4.71)	-0.08**	-0.12***	-
Mental wellbeing	51.7 (8.02)	-0.04	-0.17***	0.40***

***p<0.001, **p<0.01, *p<0.05

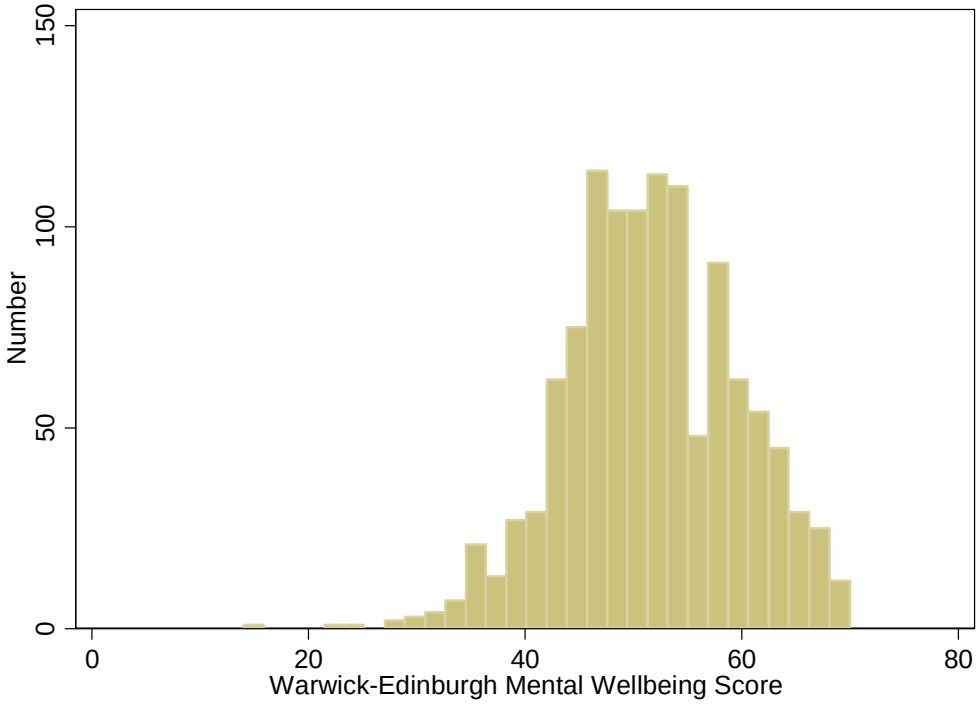
[1]Spearman correlations were used instead of Pearson correlations for variables that were categorical or had a skewed distribution: social class, income, mobility problems, index of multiple deprivation. Point bi-serial correlation coefficients were used to examine binary variables: gender and presence of limiting long term disability. [2]Median (interquartile range)

Table 2: Results of multivariate regression analysis into the relation between individual-level measures of neighbourhood environment, potential confounding or mediating characteristics and mental wellbeing (n=1157)

	Regression coefficients (95% CI)					
	Model 1[1]	**Model 2[1]**	**Model 3[1]**	**Model 4[1]**	**Model 5[1]**	**Model 6[1]**
Neighbourhood cohesion, per SD	3.05 (2.62, 3.48)***	3.05 (2.62, 3.48)***	2.90 (2.4, 3.31)***	2.43 (2.01, 2.85)***	2.48 (2.12, 2.84)***	1.99 (1.63, 2.34)***
Neighbourhood problems, per SD	-0.94 (-1.36, -0.51***	-0.90 (-1.33, -0.47***	-0.78 (-1.19, -0.36)***	-0.86 (-0.26, 0.45)***	-0.36 (-0.72, 0.003)	-0.30 (-0.65, 0.05)
Social class						
I		1.00 (-1.56, 0.18)				0.86 (-0.62, 2.15)
II		0.32 (-0.74, 2.74)				0.17 (-0.07, 1.07)
IIINM		-0.56 (-1.98, 0.87)				-0.10 (-1.23, 1.03)
IIIM		Reference				Reference
IV		-0.11 (-1.47, 1.24)				0.75 (-0.34, 1.84)
V		1.73 (-1.04, 4.54)				2.27 (1.03, 4.52)
Monthly gross income						
<£400		-1.36 (-5.88, 4.01)				-0.92 (-2.08, 0.24)
£401-£600		-0.24 (-3.38, 0.66)				-0.46 (-1.76, 0.83)
£601-£800		-0.62 (-2.07, 1.80)				0.14 (-0.90, 1.19)
£801-£1200		Reference				Reference
£1201-£1600		0.04 (-2.06, 0.83)				0.97 (-0.19, 2.13)
£1601-£2000		-0.35 (-1.52, 1.60)				0.41 (-0.92, 1.74)
>£2000		0.08 (-2.21, 1.50)				0.26 (-1.17, 1.68)
Has limiting long-term illness or disability			-1.77 (-2.82, -0.72)***			-0.67 (-1.16, 0.21)
Mobility problems			-1.22 (-1.71, -0.73)***			-1.03 (-1.43, -0.62)***
Social support, per SD				2.34 (1.92, 2.76)***		1.69 (1.33, 2.05)***
Emotional stability, per SD					4.02 (3.65, 4.38)***	3.62 (3.26, 3.98)***

[1] Model 1: neighbourhood cohesion, neighbourhood problems and sex. Model 2: neighbourhood cohesion, neighbourhood problems, sex, social class and income Model 3: neighbourhood cohesion, neighbourhood problems, sex, limiting long-term illness or disability, and mobility problems. Model 4: neighbourhood cohesion, neighbourhood problems, sex and social support. Model 5: neighbourhood cohesion, neighbourhood problems, sex and emotional stability. Model 6: neighbourhood cohesion, neighbourhood problems, sex, social class, income, limiting long-term illness or disability, mobility problems, social support and emotional stability.
***p<0.001

Figure 1: Distribution of Warwick-Edinburgh Mental wellbeing Scores



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